U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-255 601

UPPER EAGLE VALLEY SANITATION DISTRICT WASTEWATER TREATMENT FACILITY, AVON, COLORADO

ENVIRONMENTAL PROTECTION AGENCY

JUNE 1973

S-2

212056

PB 255 601

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

BIBLIOGRAPHIC DATA SHEET	1. Report No. SA/TSB-23	2.	3. Recipient's Accession No. PB-255 601
4. Title and Subtitle Upper Eagle Valley Sanitation District Wastewater Treatment Facility, Avon, Colorado			5. Report Date Jun 73 6.
7. Author(s)			8. Performing Organization Rept. No.
9. Performing Organization Name and Address Environmental Protection Agency, Denver, Colo. Technical Support Branch			10. Project/Task/Work Unit No. 11. Contract/Grant No.
12. Sponsoring Organization Name and Address			13. Type of Report & Period Covered 14.

15. Supplementary Notes

16. Abstracts

On September 14, 1972, Region VIII of the Environmental Protection Agency (EPA), received a letter from the Colorado Department of Health requesting operational assistance at the Upper Eagle Valley Sanitation District Wastewater Treatment Facility. An on-site evaluation survey of the facility was conducted by EPA on October 26 and 27, 1972 and a formal technical assistance project was initiated on March 19, 1973. This report outlines the findings and results of the technical assistance project and proposes several recommendations for future consideration at the Upper Eagle treatment plant.

17. Key Words and Document Analysis. 17a. Descriptors

*Sewage treatment,
*Eagle River,
*Gore Creek,
Design,
Recommendations,
Colorado.

Site surveys,
Waste water,
Performance evaluation,
Technical assistance,

17b. Identifiers/Open-Ended Terms

*Sewage treatment plants,
Avon (Colorado).

17c. COSATI Field/Group 13 B,

18. Availability Statement National Technical Information Service Springfield, Va. 22161	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 23
	20. Security Class (This Page UNCLASSIFIED	22. Price $3.50/$2.25

FORM NTIS-35 (REV. 10-73) ENDORSED BY ANSI AND UNESCO. THIS FORM MAY BE REPRODUCED USCOMM-DC 8265-P74

TECHNICAL ASSISTANCE PROJECT

UPPER EAGLE VALLEY SANITATION DISTRICT

WASTEWATER TREATMENT FACILITY

AVON, COLORADO

MARCH-APRIL, 1973

TECHNICAL SUPPORT BRANCH

SURVEILLANCE AND ANALYSIS LIVISION

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION VIII

JUNE, 1973

TABLE OF CONTENTS

SECTION		PAGE NUMBER
I.	INTRODUCTION	1
II.	DESCRIPTION OF PLANT	1
	A. BACKGROUND	1
	B. PLANT FACILITIES	2
III.	SUMMARY OF ASSISTANCE PROJECT	4
	A. SUMMARY OF OPERATIONAL ASSISTANCE	4
	B. PLANT PERFORMANCE EVALUATION	13
IV.	SUMMARY AND CONCLUSION	14
V.	RECOMMENDATIONS	15
VI.	REFERENCES	17

LIST OF FIGURES

FIGURES	PAGE NUMBER
1. PLANT FLOW SCHEMATIC.....	3

I. INTRODUCTION

On September 14, 1972, Region VIII of the Environmental Protection Agency (EPA), received a letter from the Colorado Department of Health requesting operational assistance at the Upper Eagle Valley Sanitation District Wastewater Treatment Facility. An on-site evaluation survey of the facility was conducted by EPA on October 26 and 27, 1972 and a formal technical assistance project was initiated on March 19, 1973. This report outlines the findings and results of the technical assistance project and proposes several recommendations for future consideration at the Upper Eagle treatment plant.

II. DESCRIPTION OF PLANT

A. BACKGROUND

Vail, Avon, and the surrounding area is provided wastewater treatment by two separate sanitation districts. The Vail Sanitation District (VSD) serves primarily the Town of Vail and discharges its effluent into Gore Creek. The Upper Eagle VAlley Sanitation District (UEVSD) serves localities upstream (the Big Horn Area) and downstream of the Town of Vail. The UEVSD discharges its effluent to the Eagle River downstream of the confluence of the River with Gore Creek.

Since a portion of the area served by the UEVSD is located upstream of the VAil facility, an agreement between the two districts was reached providing for a portion of Vail's collection lines to be used by the UEVSD to transport sewage to the Upper Eagle treatment plant.

Flow from the Big Horn area is measured prior to entering the Vail interceptors. This flow is transmitted to the Vail plant along with sewage from

Vail. At the Vail facility the flow is split and an amount approximately equal to that flow measured from the Big Horn area is directed to the UEVSD plant. Vail is required to pay the UEVSD for all wastewater sent to the UEVSD plant in excess of that measured at the Big Horn metering station. It is noted that the interelationship that exists between the plants provides a means to adjust flows to a desired quanity between the two facilities and therefore must be considered an important operational tool.

B. PLANT FACILITIES

Figure 1 shows a plant flow schematic of the Upper Eagle Wastewater Treatment Facility. Flow enters the facility and passes through a bar screen, grit channel, parshall flume, and comminutor before entering the aeration basin. Flow continues through the aeration basin, final clarifier, and chlorine basin before it is discharged to the Eagle River. Sludge removed in the final clarifier is collected by a vacuum type sludge scraper mechanism and is returned to the aeration basin by a constant speed centrifugal pump. Return flow may be adjusted by opening or closing a plug valve located at the return sludge discharge point in the aeration basin. The pretreatment facilities and/or the aeration basin and secondary clarifier may be bypassed by opening and closing the appropriate gates and valves.

Sludge is wasted from the bottom of the secondary clarifier through an air lift pump to the aerobic digester. Digested sludge is drained to a sludge drying bed and digester supernatant is directed back to the aeration basin. Dissolved oxygen and mixing is provided in both the aeration basin and aerobic digester by air blowers coupled with surface and subsurface mechanical agitators.

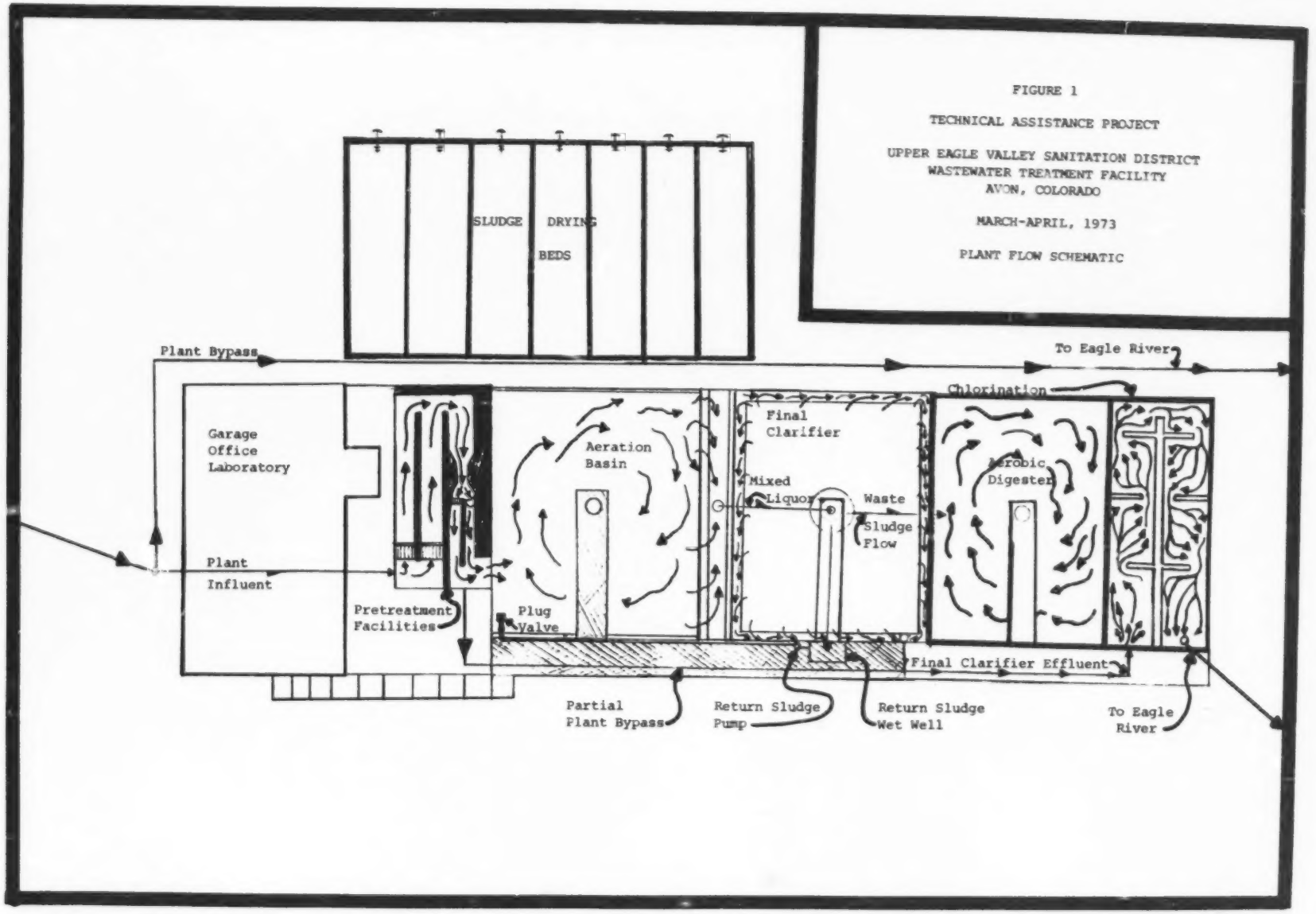
FIGURE 1
TECHNICAL ASSISTANCE PROJECT
UPPER EAGLE VALLEY SANITATION DISTRICT
WASTEWATER TREATMENT FACILITY
AVON, COLORADO
MARCH-APRIL, 1973
PLANT FLOW SCHEMATIC
SLUDGE DRYING BEDS
Plant Bypass
To Eagle River
Chlorination
Garage
Office
Laboratory
Aeration Basin
Final Clarifier
Aerobic Digester
Mixed Liquor
Waste Sludge Flow
Plant Influent
Pretreatment Facilities
Plug Valve
Final Clarifier Effluent
Partial Plant Bypass
Return Sludge Pump
Return Sludge Wet Well
To Eagle River

III. SUMMARY OF ASSISTANCE PROJECT

A. SUMMARY OF OPERATIONAL ASSISTANCE

At Upper Eagle the primary emphasis of the assistance project was on operational control of the facility. No formal assistance was given on procedures used to conduct various monitoring tests such as biochemical oxygen demand (BOD_5) and total suspended solids (TSS). During the project the BOD_5 and TSS analysis were performed by an EPA chemist. After completion of the Upper Eagle assistance project a few BOD_5 and TSS analysis were conducted by plant operators at the Vail facility.

Presently it is not feasible for plant operators at Upper Eagle to routinely perform BOD_5 and TSS analysis because of the limited manpower available and lack of the necessary equipment at the facility. The necessary laboratory equipment should be purchased to enable plant personnel to run selected monitoring analysis.

Control over plant operation at the Upper Eagle Treatment Facility involved conducting various "control" tests and interpreting the corresponding results. The control tests used were dissolved oxygen, centrifuge turbidity, settleability, and sludge blanket depth. The centrifuge turbidity and sludge blanket depth tests were conducted four times per day, seven days per week, the settleability test was conducted two times per day, seven days per week, and the dissolved oxygen test was conducted periodically during the assistance project. After assistance the control tests were conducted twice per day during the days when a plant operator was at the facility.

The dissolved oxygen (D.O.) tests were used to monitor the D.O. concentration

in the aeration basin and aerobic digester. For both the aeration basin and aerobic digester the D.O. test was used to insure that the D.O. concentration was maintained greater than 1 mg/l.

The centrifuge tests were used to determine the variations in solids concentrations from day to day. Tests were conducted on samples of mixed liquor taken at the discharge end of the aeration basin, on samples of return sludge, on samples of sludge in the aerobic digester, and on samples of sludge wasted to the aerobic digester. Although it is not necessary for control, a correlation between percent solids by volume and solids by weight was made. The results of this correlation indicate that during the project one percent by volume was approximately equal to 1,000 mg/l by weight. This correlation will vary as the characteristics of the sludge vary. For this report all solids concentrations by weight were determined using the correlation of one percent by volume equal to 1,000 mg/l by weight.

The turbidity tests were performed on samples of clarified supernatant from the final clarifier. Test results were used to monitor the performance of the activated sludge process prior to obtaining a BOD_5 result.

The settleability tests were conducted on samples of mixed liquor collected at the discharge end of the aeration basin. The tests were used to monitor and observe sludge settling characteristics.

Sludge blanket depth determinations were made on the final clarifier. Results were used to monitor the changes in the depth of the sludge blanket and to determine the amount of sludge that was accumulating in the final clarifier.

Data obtained from the control tests were used to perform calculations and develop gfaphs which were used to interpret plant performance and control

plant operations. After completion of the assistance project Upper Eagle purchased all the necessary equipment to conduct the "control" tests and are using the tests, calculations, and graphs to control plant operation.

Initiation of process control pointed out various procedures that must be used to control plant operations and in addition pointed out various limitations in plant design which hindered plant performance.

One of the major factors limiting performance was inadequate control over the return sludge flow rate. Return sludge flow control is necessary to provide control of the MLSS concentration throughout the day as the sewage flow rate varies. This fact is increasingly important at Upper Eagle because of the relatively short detention time in the aerator (4.5 hours at the design flow of 4,163 cu m/day (1.1MGD)) for a plant of this type (i.e. no primary clarifiers).

Two major reasons for the lack of adequate return sludge flow control are insufficient manpower provided at the facility and inadequate physical control over the return flow rate. Two plant operators are available to cover plant operation eight hours per day, six days per week. These same operators; however, are responsible for the collection system and at times cannot be at the treatment plant for even the limited time of eight hours per day, six days per week. To provide for adequate return sludge flow control an operator must be at the plant to adjust the return flow rate during the times when the sewage flow increases and decreases. This normally represents a minimum time of sixteen hours per day seven days per week for a plant of this size.

Sludge is returned to the aeration basin at Upper Eagle through one constant speed centrifugal pump at a constant rate of approximately 3,785

cu m/day (1 MGD).

This constant return rate represented a fluctuation in the return flow percentage (i.e. ratio of return sludge flow rate to incoming sewage flow rate) of about 85% to about 200%. Before plant operators can control the return flow rate there had to be a physical method developed to accomplish the control. During assistance two methods were developed to try and control the return flow rate. The first method involved using a pressure switch activated by the liquid level in the return sludge wet well. The second method involved installing a plug valve on the return sludge discharge line to the aeration basin. This method of control was partially successful and allowed the flow rate to be adjusted lower than the maximum output of the return sludge pump. Although the rate of flow of return sludge could be adjusted the flow rate could not be measured. No return sludge flow measuring devices are provided at the Upper Eagle facility. Attempts were made to estimate the flow rate, but a good estimation could not be made. It is recommended that a flow measuring device be provided.

Additional problems with return sludge flow adjustments were also encountered after the plug valve had been installed. The sludge collection mechanism in the final clarifier at Upper Eagle is a vacuum type scraper mechanism that has a center wet well connected to the sludge pick up ports. The center wet well revolves around the fixed center support column. The joint between the support column and the wet well is sealed by a flexible rubber gasket which is provided to prevent the mixed liquor that enters the clarifier from leaking into the return sludge wet well. During assistance this seal was leaking and mixed liquor was allowed to dilute the return sludge. The effects of this dilution became more and more pronounced as the return

sludge flow was decreased. For example, when the return rate was decreased a greater percentage of the return flow consisted of mixed liquor and a lower percentage consisted of settled sludge from the bottom of the clarifier. Eventually the settled sludge in the clarifier became thicker and thicker and plugged the sludge pick up ports. At that point the return flow consisted entirely of mixed liquor leading through the seal and no settled sludge in the clarifier could be returned to the aeration basin. Because of the limitation caused by the leaky seal, the return sludge flow rate adjustments were very ineffective in controlling the MLSS concentration in the aeration basin.

It was pointed out by the plant operators that the leaky seal had been repaired approximately one year prior to the assistance project. It is recommended that the seal be repaired once again and that in the future the seal be checked at least twice per year and replaced when necessary.

Another major plant deficiency that limits plant performance at Upper Eagle is the size of the aeration basin. The plant flow pattern is designed in a similiar fashion to an extended aeration facility, (i.e. no primary clarifier, one aeration basin). However, at the average daily design flow (4,163 cu m/day(1.1 MGD)), the aeration basin detention time is 4.5 hours rather than the 24 hours normally associated with extended aeration facilities. The detention time at average flow during assistance (2,649 cu m/day(0.7 MGD)) was 7.1 hours which is still significantly less than a typical 24 hours. One of the disadvantages of designing a plant with conventional detention times (i.e. 4-6 hours) and no primary clarifier is that settleable organic material is recycled with activated sludge (i.e. it settles in the final clarifier and is returned with the activated sludge to the aeration basin).

This settleable organic material is in most cases more difficult to break down by bacteriological activity and as a result must be recycled many times in a system that has a short aeration time in order to achieve a stable end product. The effect is to overload the system and reduce the quantity of settleable organic material converted to a stable end product and quantity of colloidal and dissolved organic material converted to settleable sludge solids. An approach to increase these conversions is to carry a higher MLSS concentration. The higher MLSS concentration in part compensates for the shorter aeration basin detention time. The problem encountered in this approach is that the size of the aeration basin (small) and final clarifier (large) establishes an interrelationship that directly affects the systems ability to maintain a selected "activated" MLSS concentration. Generally a small aerator is associated with systems that have lower MLSS concentrations (high rate systems).

Another limitation in plant design at Upper Eagle that indirectly affects plant performance is the aerobic digester capability at the facility. During assistance the digester was not performing satisfactorily and as a result removal of excess sludge from the activated sludge portion of the plant was severely hindered. The poor digester performance was characterized by a sludge that would not develop a clear supernatant layer even after extended periods of quiescense (i.e. 24 hours). To allow room for waste sludge in the digester, sludge had to be drawn to the snow covered drying beds. Several factors which contributed to the inadequate digester performance during the assistance project were excessive solids loading to the digester, low temperature of the digester contents, and inadequate detention time in the digester.

Approximately one week before and during the assistance project, large quantities of sludge were wasted to the aerobic digester within a short time period. The purpose of wasting a large quantity of sludge within a short time period was to aid in attaining the optimum MLSS concentration. The effect of the heavy solids loading to the digester was that normal digestion appeared to be upset and adequate supernating in the digester was prevented. Future plant operations should strive to achieve a balance in solids distribution in the plant so that heavy solids loadings to the digester are avoided.

A second factor, low temperature in the digester, was felt to be the leading cause of inadequate digester performance during assistance. Frequently the temperature of the sludge in the digester was so low that ice formations were observed in and around the edges of the digester. The low temperature of the sludge caused the microorganisms to be less active and therefore decreased the rate of sludge digestion. A cover over the existing digester would help this situation to a degree but other considerations such as an external heat source or alternate means of ultimate sludge disposal must be considered to compensate for the decreased sludge digestion rate caused by lower temperatures.

A thorough analysis of the detention time in the digester was not made because sufficient data was not obtained during the project. The design detention time; however, is 5 days (2). This design detention time is not sufficient for adequate digestion. It is recommended that a thorough analysis be made of the detention time in the digester, with respect to adequate digester performance, prior to initiating major modifications apparently necessary at the Upper Eagle facility. A suggested minimum detention time for

an aerobic digester associated with a plant like Upper Eagle's is 20 days (3).

Another limitation in plant design that degraded plant effluent quality was the absence of a skimmer in the final clarifier. No method of removing floating material is available at the Upper Eagle facility and as a result the plant effluent quality is degraded. It is recommended that a skimming device be provided.

The plant limitations that have been outlined above inhibited the ability to provide adequate operational control at the Upper Eagle facility. Therefore, operational assistance turned into developing methods to make the best of the required mode of operation.

During the assistance project the sewage flow rate to the Upper Eagle facility was increased because of the sever problems that were being encountered with plant operation at the Vail Wastewater Treatment Facility. Future operation of the Upper Eagle facility should include the capability to reduce flow by letting Vail take on an additional volume of sewage. This interrelationship is a useful tool that must be fully developed between both facilities. It is noted that the increased flow at Upper Eagle during assistance did cause a slight deterioration of plant effluent quality.

The method of wasting activated sludge was modified to conserve digester capacity and to account for the quanity of solids wasted. As thick a sludge as possible was wasted to the digester by shutting off the return sludge pump and allowing the sludge to accumulate and concentrate in the secondary clarifier. This sludge was then wasted to the digester at as slow a rate as possible. It is recommended that sludge continue to be wasted as thick as possible until adequate digester performance is attained. At that time a thick sludge should continue to be wasted but the return sludge flow rate should not be stopped

prior to wasting. Each time sludge was wasted the concentration was determined using the centrifuge. The volume of sludge wasted was determined by measuring the volume occupied by the wasted sludge in the digester. Using both the volume and concentration of sludge wasted the quantity of sludge removed from the activated sludge system was determined. It is recommended that this method of determining the amount of sludge wasted be used in future plant operations.

At the beginning of the federal assistance project, the Upper Eagle plant was glutted with sludge solids which were being rapidly recycled throughout the system by the constant high return sludge flow rate. By interpreting the control tests and by analyzing unit sizes various operational changes were concluded. In summary, it was decided to increase the MLSS to as high a concentration as possible to obtain the best treatment using the minimum aeration basin detention time provided. The approach to increasing MLSS is outlined as follows: Excess sludge was in the system and was hindering the activated sludge's ability to dewater. This excess sludge was wasted. As the excess sludge was wasted the settleability tests indicated that the remaining sludge in the system dewatered much better to almost twice the concentration as with prior tests in a given time period (i.e. 60 minutes). A plug valve was installed so that return sludge rates could be decreased to take full advantage of the sludge's ability to dewater and to limit the quanity of excess water that was being recycled to the aeration basin. This mode of operation, if it had been successful, should have produced the highest effluent quality. However, wasting limitations, inadequate return sludge control, leaky seals in the clarifier, and other problems forced this method of operation to be abandoned.

The return sludge flow rate, by necessity (i.e. to prevent plugged sludge pick up ports in the clarifier because of leaky seals), was returned to its original high rate and the maximum MLSS concentration was achieved by allowing the solids in the system to build and still avoid bulking in the final clarifier. This method of operation is highly undesirable in light of the control the operators could have if adequate facilities and controls were available.

B. Plant Performance Evaluation

During assistance plant performance at Upper Eagle was satisfactory, (effluent BOD_5 and TSS was approximately 25 mg/l except during the higher flow period as explained above when effluent BOD_5 and TSS was about 40 mg/l). However, it is felt that a consistent, high quality effluent would be difficult to maintain due to inadequate control over the treatment plant operation and limitations in plant design. Inadequate control over plant operation was due primarily to inadequate control over the return sludge flow rate. Control over the return flow rate was not provided because of limited manpower available at the plant, leaky seals in the final clarifier, and inadequate physical control over the return rate itself. Physical control over the return rate was provided during the assistance project by placing a plug valve on the return sludge line. Using the plug valve the return sludge flow rate can be adjusted. The adjustments; however, cannot be used to adequately control plant operation until the leaky seals in the clarifier are repaired and adequate manpower at the plant is provided. It should also be noted that only one return sludge pump is provided at Upper Eagle. It is apparent that if repairs are required on that pump the entire return sludge flow capability is eliminated and plant effluent quality would deteriorate. To prevent complete

elimination of the return sludge capability during periods of pump maintenance it is recommended that a separate return sludge pump be provided at Upper Eagle. It is also recommended that the leaky seals in the clarifier be repaired and that adequate plant staffing be provided. At that time the plug valve or some other method of controlling the return flow rate should be used and plant operation should be controlled in order that the most consistent, highest quality effluent be attained with the facilities available.

IV. SUMMARY AND CONCLUSIONS

Region VIII of the Environmental Protection Agency received a letter from the Colorado State Department of Health requesting assistance concerning the operation of the Upper Eagle Valley Wastewater Treatment Facility. An initial evaluation of this plant was made on October 26, 1972 and a formal technical assistance project was initiated on March 19, 1973.

During assistance, plant personnel were given instruction in conducting and interpreting various process control tests. Results from these tests pointed out various procedures that must be used to control plant operation and in addition pointed out various limitations in plant design which hindered plant performance.

One of the major factors limiting plant performance was inadequate control over the return sludge flow rate. A plug valve was installed so that the return rate could be physically adjusted; however, limited manpower at the facility and a leaky seal in the clarifier prevented attempts to control this rate. In addition to this lack of return control, the return flow rate could not be measured.

Another plant deficiency that limits plant performance is the size of the aeration basin. The basin is too small for the type of facility that exists at Upper Eagle and a consistently high quality effluent would be

difficult to achieve and maintain. In future plant modifications consideration should be given to expanding the aeration basin facilities.

Inadequate digester performance indirectly affected plant performance during the assistance project. The reasons for poor performance were cold temperature of the digester contents, inadequate detention time in the digester, and excessive solids loading to the digester. Present digester performance can be improved by providing proper wasting control of excess activated sludge and by modifying the digester to include placing a cover over the digester and possibly providing an external heat source to heat the digester contents. An alternate means of ultimate disposal should also be considered. In addition expansion of the digester capacity to allow for a longer sludge detention time appears to be necessary.

Another plant limitation at Upper Eagle is that no method of removing floating material is available. The obvious effect of this limitation is a degraded plant effluent.

Although various operational changes were initiated during the Upper Eagle assistance project, plant deficiencies inhibited proper operational control. This lack of operational control limited the improvement of effluent quality and required an operational mode to be continued that was highly undesirable.

V. RECOMMENDATIONS

Based on the results of the technical assistance project the following recommendations are made:

1. Purchase the necessary laboratory equipment to enable plant personnel to run selected monitoring analysis.

2. Provide a flow measuring device on the return sludge flow line so that the flow rate can be accurately measured.

3. Repair the leaky seal in the final clarifier as soon as possible and in the future check the seal at least twice per year and replace it when necessary.

4. Maintain the relationship between the Vail and Upper Eagle Treatment Facilities so that additional flow can be accepted at one facility when the other is experiencing operational difficulties.

5. Provide an alternate return sludge pump that can be used when the existing pump is out of service.

6. Future plant expansion at Upper Eagle should include consideration of enlarging the existing aeration basin capacity. In the interim period a lower flow capacity would be desirable.

7. To aid present digester performance a cover should be placed over the digester. Also consideration should be given to providing an external heat source or an alternate means of ultimate sludge disposal to insure continued operation in winter months. Any plant expansion should investigate the sludge detention time in the existing digester which is believed to be inadequate.

8. Place a shimmer on the final clarifier to remove floating material from the waste stream.

9. Provide adequate plant staffing to control plant operation during periods of increasing or decreasing sewage flow or for a minumum of 16 hours per day, 7 days per week.

10. Continue conducting the operational control tests and operational practices that were initiated during the assistance project.

VI. REFERENCES

1. "Operation and Maintenance Manual, Sewage Treatment Plant, Upper Eagle Valley Sanitation District".

2. "Process Design Manual for Upgrading Existing Wastewater Treatment Plants" prepared for the U. S. Environmental Protection Agency by Roy F. Weston, Incorporated, Contract No. 14-12-933, U. S. Environmental Protection Agency, Region VIII, Denver, Colorado 80203 (October, 1973).